

MODIS Quarterly Report, Mar 1998

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This reports covers the **aerosol ocean** and **aerosol land** algorithm, the **NIR water vapor** algorithm and our involvement in the **fire algorithm**.

Main topics addressed in this period:

1. Dust aerosol optical model developed. (Kaufman, Tanré, Karnieli, Fraser)
2. Post-launch processing requirements determined (Remer, Kaufman, Chu, Mattoo)
3. MODIS Atmospheric group retreat at St. Michaels MD (Kaufman, Tanré, Gao, Remer, Chu, Mattoo, Li, Kleidman, Wald)
4. Analysis of SCAR and TARFOX experiment data including MODIS algorithm validation (Kaufman, Tanré, Kleidman, Ji, Mattoo, Remer, Li, Chu,)
5. AVHRR smoke-cloud interaction study (Ramaprasad, Remer, Kaufman, Fraser)
6. SCAR and TARFOX data analyzed including algorithm validation and evaluation (Kleidman, Li, Remer, Kaufman, Chu, Mattoo)
7. Fire burn scar analysis completed (Kleidman, Kaufman)
8. Surface properties in the mid-IR and the visible: (Wald, Karnieli, Kaufman, Remer)
9. Aerosol ATBD updated (Mattoo, Remer)
10. Preparations for upcoming field projects (Remer, Ji, Wald, Karnieli, Nelson).
11. Organization and calibration of Microtops II sunphotometers and analysis of first data set from Egypt (Li, Kaufman, Remer)
12. Aerosol group web page updated (Kleidman)
13. Meetings attended: (Kaufman, Tanré, Remer, Wald, Li, Chu, Kleidman, Mattoo,)
14. Papers published
15. Papers submitted

Topics postponed (or continued) to next quarter

1. Smoke-cloud interaction analysis
2. Comparison of IR dust retrieval with AVHRR retrieval for selected images near African coast.

Plans for the next quarter:

1. Submission of proposal for TRMM study with Roelof Bruintjes of NCAR.
2. In depth analysis of Israel spectra data: algorithm assumptions testing and vegetation indices analysis.
3. Acquisition of more TM data for further algorithm testing and evaluation.

1. Dust Optical Model Developed

Using a combination of AERONET data at Cape Verde and Sede Boker with TM images over Senegal a powerful method was developed to determine dust optical properties including phase function, non-sphericity effects and single scattering albedo. The real part of the refractive index is also determined, but to less accuracy. The dust is surprisingly less absorbing than the WMO models suggest. The dust observed on the eastern (Sede Boker) and western (Cape Verde) sides of the Sahara show very similar results which supports the generalization of the results. The method can be applied to other aerosol in other places.

2. Post-launch processing requirements determined

In order to evaluate and validate our algorithms we will need to process MODIS data in near real-time. Ed Masouka is interested in doing this processing for us. We outlined what our requirements will be. First of all, we need the MODIS data processed all the way to L3. For L2 data, we need to subset data around AERONET sunphotometer sites. These data will be archived in the AERONET data base and accessed through demonstrat software. We will be able to simultaneously call up MODIS and AERONET time series data for evaluation. For L3 data we need daily plots of the global aerosol and water vapor fields. We want these plots on hard copy and we expect to archive the paper copies as well as the electronic. We also need access to computing facilities and the on-line files in order to make changes to the algorithm and test these changes with actual MODIS radiances. A full list of requirements is attached as an Appendix.

3. Atmospheric Group retreat at St. Michaels MD

We participated in the interaction of the MODIS Atmospheric Group in February. Allen Chu presented the status of the aerosol and water vapor retrieval algorithms.

4. AVHRR Smoke-Cloud Interaction Study

50 images of AVHRR data from South America in 1993 and 1995 were acquired and will be analyzed for cloud-aerosol interaction and the possible role of water vapor on the interaction. AVHRR analysis program was modified to accept water vapor correction to ch3 and ch4 radiances for any geometry or image, given DAO analyzed water vapor field. Sensitivities to different assumptions quantified. In parallel, the AVHRR processing code of the GEMS group led by Eric Vermote and Nazmi El Saleous is undergoing modification and testing in order to proceed with the project.

5. Field Experiment (SCAR and TARFOX) Data Analysis

SCAR:

- 1) MODIS aerosol over land algorithm applied to SCAR-A and SCAR-B AVIRIS and MAS imagery above co-located AERONET radiometers for validation. Plots and images presented at St Michaels retreat.
- 2) MODIS near-IR water vapor algorithm applied to MAS data from SCAR-B. Results are horrible. Conclusion that the spectral location of MAS channels at $0.94\ \mu\text{m}$ is not sufficiently well defined to do the retrieval. AVIRIS images will be looked at and an empirical fix to the MAS data will be made in order to make full use of the SCAR-B data set.

TARFOX:

- 1) TARFOX MAS imagery used to test MODIS retrieval algorithms over sea. The ocean retrieval shows generally favorable results when compared to in situ measurements. In particular, comparisons of effective particle size between the retrieval and in situ measurements aboard the UKMO C130 aircraft are good. Most of the MAS images are plagued with sunglint which makes retrieval difficult. Questions about the retrieval remain. We hope to submit a paper to the TARFOX special issue Part II in mid-1998.
- 2) Analysis of SCAR-A and TARFOX AERONET data for interannual variability of eastern U.S. aerosol. TARFOX was generally less hazy and more regionally uniform than SCAR-A. However, the important characteristic of a dynamic accumulation mode increasing in particle size with increasing optical thickness dominates the TARFOX data set; thereby, supporting the use of the dynamic model in the MODIS land aerosol algorithm. Paper submitted for TARFOX special issue, Part I.

6. Burn scar analysis completed

MODIS will derive the thermal energy emitted from pixels identified as fire pixel. So far there is only a theoretical relationship between the emitted energy and other biomass burning quantities such as the rate of consumption of biomass or the rate of emission of particulates and trace gases. We use MAS data from SCAR-B to measure the increase of burn scar size over time for individual fires observed several times on the same day during SCAR-B. Same data are also used to derive the rate of emission of thermal energy as a function of time. Comparison between the integrated rate of emission of thermal energy and the increase in the burn scar established a relationship between biomass burned and fire thermal energy.

7. Surface Properties in the Mid-IR and visible channels

Preliminary analysis of the May 1997 Israeli data show a relationship between reflectance in the mid-IR and the visible. For three days of data, the slope in the blue is 0.22, 0.28 and 0.32. For the three days of data the slope in the red is 0.52, 0.63, 0.73. These numbers were derived from a linear regression on a mass scatter plot

that does not discriminate between different land surface types. Further analysis will be made in order to understand the day to day variability. Also, a second trip to Israel is planned although smaller in scope. The object of the second trip is to do a vegetation and soil survey of the land surface targets of last year's study in order to help with the understanding of the variability in the results.

8. Aerosol ATBD updated

The ATBD for the aerosol products was very much out of date. It was revised and will soon be uploaded onto the web.

9. Upcoming Field Projects

During the past quarter preparations have been made for various upcoming or current field projects.

- 1) South China Sea. Prepared instruments for South China Sea experiment. Assembled the optical bench. Tested the radiometers and the datalogger.
- 2) Israel soil and vegetation survey. In late May 1998, we will visit the sites on the ground, observed from the air last spring to categorize vegetation and soil at these sites.
- 3) SAFARI 2000. Validation experiment planned for southern African during the dry season in late summer in 1999 and 2000. A basic planning meeting is scheduled for late June. Preliminary discussion of objectives and identification of key collaborators began last quarter.
- 4) Student summer project. Using a digital camera with a red filter, a spherical mirror and sunphotometer measurements a summer student will collect several weeks of data this summer on cloud fraction, water vapor and aerosol connections. This past quarter the equipment was acquired and the mirror distortion correction was derived.
- 5) Rapid Assessment Team (The RATS). The RATS have been organized in order to react quickly to interesting global aerosol phenomena (such as biomass burning and volcanic eruptions). Personnel have been identified and equipment and information acquired.

10. Microtops II sunphotometer data

A small project involving 4 Microtops II Solar sunphotometers has been initiated. The instruments were calibrated against the AERONET master instrument. One instrument resides in Alexandria, Egypt. Dr. Ismail Sabbah has been directing the collection of daily data in Alexandria. The first results from this instrument show an interesting correlation between dust events and high precipitable water vapor. The idea behind this project is to have simple, easily transportable instruments in order to augment the AERONET network for validation after launch.

11. Web Page

The web page is under revision. It will be moved to the 913 branch server climate.gsfc.nasa.gov.

12. Meetings attended

Atmospheric Group retreat, February (Kaufman, Tanré, Gao, Remer, Chu, Mattoo, Li, Kleidman, Wald)
Indonesia Fire Workshop, March (Remer)
GOIN workshop, March (Remer)

13. Papers Published

Hegg, D.A. and Y.J. Kaufman, Measurements of the relationship between submicron aerosol number and volume concentration. J. Geophys. Res., 103, 5671-5678, 1998.

14. New papers submitted this quarter

L.A. Remer, Y.J. Kaufman, and B.N. Holben, Interannual variation of ambient aerosol characteristics on the east coast of the United States. *submitted to the J. Geophys. Res., TARFOX special issue.*

A. A. Gitelson and Y. J. Kaufman, AVHRR & MODIS NDVI data continuation - spectral considerations, submitted to Rem. Sens. of Environ.

Y. J. Kaufman, D.D. Herring, J. Ranson, and J. Collatz, "Earth Observing System AM mission to Earth", accepted to IEEE TGARS special issue on EOS.

Appendix: Post-launch computing requirements

I. Save L2 time series at selected sites

A. Maximum 60 locations at any one time

- 1) Will specify by latitude \pm Del latitude and longitude \pm Del longitude
- 2) Collect data for all "pixels" that fall within the specified ranges
- 3) Maximum Del latitude and Del longitude will be 1 degree.

B. Need flexibility in specifications of latitudes, longitudes and Dels

- 1) Will not change maximums

C. All L2 products should be saved

- 1) 11 products at each pixel, as per the ATBD

D. Would like to transfer these files automatically to AERONET data base

II. Save L3 digital files

- A. All L3 data products should be saved daily
- B. All average periods (8 days, monthly) should also be saved
- C. At least 8 days of daily data should be on line at all times
 - 1) Archive daily files after 8 days
- D. All 8-day and monthly mean global maps remain on line for a year.

III. Create automatic statistical analysis of L3 data

- A. presently not defined
- B. General thoughts: histograms, regressions, jpdf, time-series

IV. Create hard copy displays of L3 global maps

- A. Color contour maps overlaid onto continental outlines
- B. 4 panels per page (land and ocean)
 - 1) mean optical thickness at 550 nm
 - 2) std dev of tau550
 - 3) max tau550
 - 4) min tau550
- C. 4 panels per page (land only)
 - 1) optical thickness 440 nm
 - 2) optical thickness 670 nm
 - 3) optical thickness difference
 - 4) dark target criterion
- D. 4 panels per page (ocean only)
 - 1) reff
 - 2) rm small
 - 3) rm large
 - 4) ratio
- D. Produce daily hard copies and one set for each averaging period

V. Processing and computing

- A. Processing above information needs to be done in almost real time
 - 1) We need access to "yesterday's" data.
 - 2) At maximum, we need access to Monday's data by Wednesday
 - 3) Hard copy maps especially important
- B. We need computing facilities and access to on-line files
 - 1) to apply our own more indepth analysis
 - 2) to test changes to algorithm
 - 3) to re-run algorithm